

Luminosity Ratio Analysis

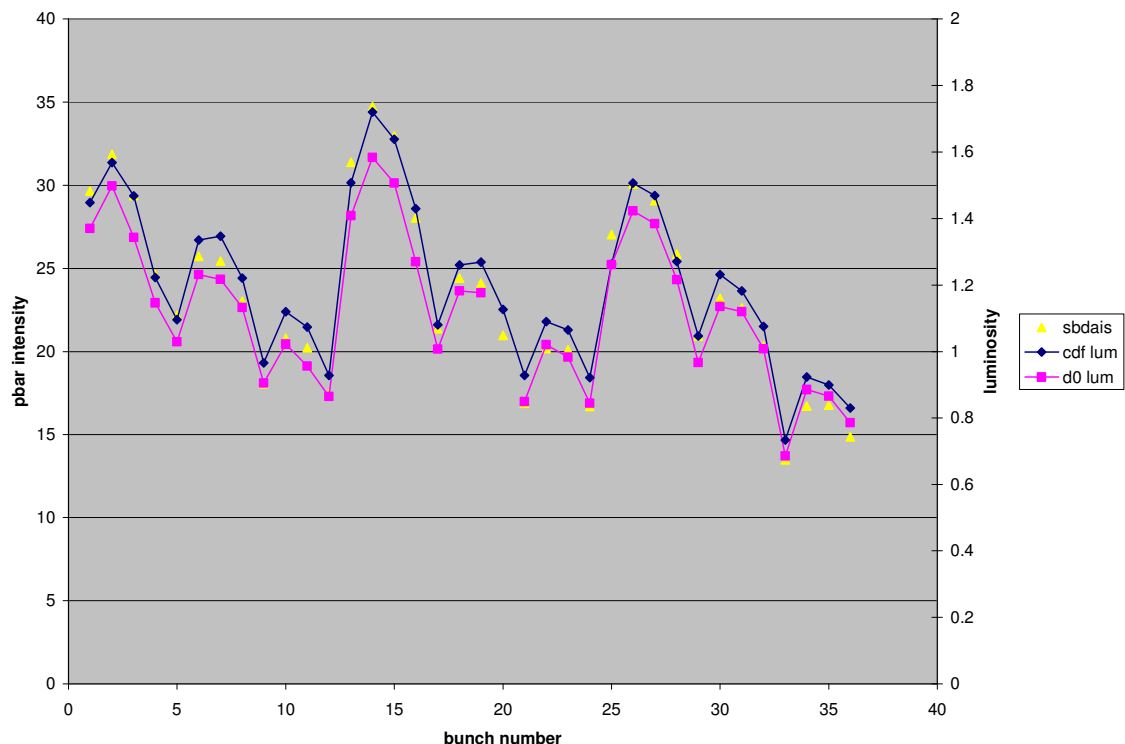
Saul Lipton

There are a few steps I used to perform a reasonably accurate analysis of how the luminosity ratio between CDF and D0 varies with luminosity. I take advantage of the luminosity differences between bunches in the TeV to see if the ratio between CDF and D0 correlates with luminosity.

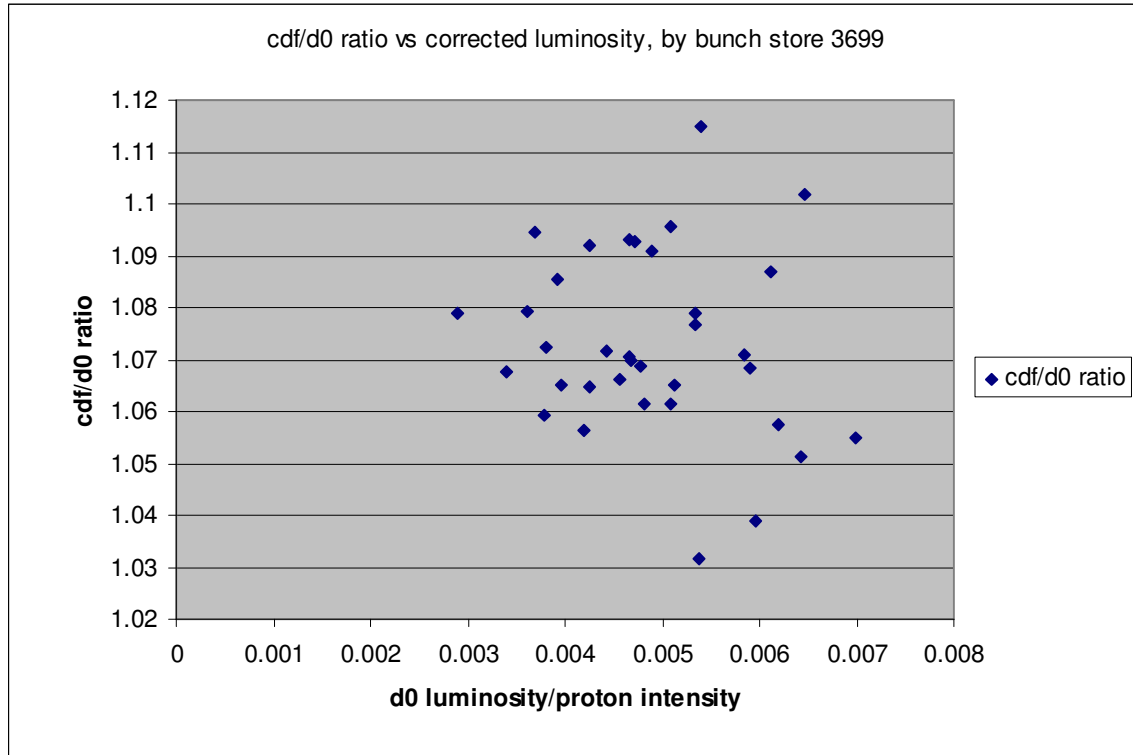
First step- get data.

I used data from SDA in a preliminary analysis, but using higher-frequency data from D44 would lead to less error in the luminosities, so for this study I used D44 data. The devices used were: C:B0ILUM, an array of the CDF luminosity bunch-by-bunch; C:D0FL01 through C:D0FL36 were the bunch-by-bunch luminosity devices for D0; and T:SBDAIS and T:SBDPIS were used to calibrate the luminosity. I got data for all of these devices from a D44 data logger plotter for 47 seconds in the early part of a store. I put all of this data into an Excel spreadsheet for manipulation. This provides around 4 or 5 points of data for each device, which I then averaged.

In order to be able to correlate the D0 and CDF luminosity bunch by bunch, one must correct for the different proton and pbar bunch numbers that collide at each IP. The pbar bunch intensity is known to be highly correlated with the luminosity of a given bunch, so correcting the bunch luminosity arrays to have a common pbar bunch number is an appropriate way to do it. To do this in Excel, I simply cut-and-pasted the D0 luminosity so that the 25th bunch in the original data became the 1st bunch; for CDF, the 13th bunch became the 1st bunch. Make sure that the data loops around; that is, for D0, the former 1st bunch would now be in the 13th position in the new array. This is similar for CDF. I used the T:SBDAIS pbar intensity array to make sure that the CDF and D0 luminosities correspond to the appropriate pbar bunch number:



Once this check has been made, it is possible to use the T:SBDPIS to correct the luminosity data for varying proton intensity. The original luminosity array indices correspond to proton bunch number, so no indexing correction has to be made. In the future, it would be easier to do this step before changing the indices to correspond to the pbar intensity. I simply divided the luminosity by the proton intensity for both arrays, and stored it in an additional array. A simple plot of the ratio of the corrected luminosities vs the D0 or cdf luminosity is easy to make from there:



This plot shows a possible correlation, but it should be said that by plotting the bunches with individual colors it can be shown that the 4 data points in the lower right part of the plot correspond to only two positions in the trains of bunches (a train is a period of 12 bunches that shows a specific pattern, and there are three trains in the TeV). One position in the train could correspond to bunches 1, 13, 25. More exploration may be necessary to see if a bunch's position in the train affects the ratio in luminosities.

While the results of this plot do not look definitive, it must be noted that this data was taken several hours into store 3699, when the luminosity was not at its highest. The period when the correlation between luminosity and ratio is greatest is at highest luminosities, so this analysis must be repeated with better data. I have recently discovered that the D0 luminosity data has in fact been data logged as C:D0ILUM in the 15 second TeVJA datalogger. Further studies are immediately possible.